

REMARKS/ARGUMENTS

In response to the Office Action mailed March 28, 2006, Applicants amend their application and request continued examination. In the foregoing Amendment claims 4, 19, and 28 are newly cancelled leaving claims 2, 5, 7-12, 14-18, 26, and 27 pending.

In the foregoing Amendment, in view of the remarks made by the Examiner concerning the relationship between certain previously presented arguments and claim language, claims 2, 10, and 17 are amended to point out expressly that the optimization filtering acts before the control program is compiled by the compiler. Other claims are clarified by no longer referring to a controllable block and explaining that each of the blocks that is referred to includes at least one rung, i.e., one or a plurality of rungs. Further, several references to at least one cache are replaced by reference to pipeline logic. All of these amendments are clearly supported by the application as filed.

Prior Art Rejections

The outstanding prior art rejections with regard to the claims presented here are as follows.

Claims 5, 7-9, and 26 are rejected as anticipated by an article by Kim.

Claims 2 and 10 are rejected as obvious over Kim in view of a book by Aho.

Claim 11 is rejected as unpatentable over Kim in view of a book by Chester.

Claims 12, 14-16, and 27 are rejected as unpatentable over Kim in view of McGrath et al. (U. S. Patent 5,504,902, hereinafter McGrath).

Claim 17 is rejected as unpatentable over Kim in view of McGrath and further in view of Aho.

Claim 18 is rejected as unpatentable over Kim in view of McGrath and further in view of Chester.

Reply to Prior Art Rejections

Claim 2 describes a control-program-development supporting apparatus comprising a compiler producing a control program directly executable by a

microprocessor, and an optimization filtering unit. The optimization filtering unit of claim 2 also provides for recombining of logical operations. The optimization filtering unit permits the production of a compact and optimum execution code by reconstituting codes with the optimization filter before inputting a control program, such as an instruction list, to the compiler. Amended claim 2 makes clear, in response to the comment from the Examiner, that the control program is optimized before the control program is converted into a programming language. Consequently, the execution efficiency of the execution code is improved after the compiling, as described at page 48, lines 8-14 and page 49, lines 4-6 of the patent application.

Kim describes a method of translating a ladder diagram (LD) into a native code of a processor. The method includes three steps, one in an LD/mnemonic converter, another in a macro compiler, and a third in an assembler. In the LD/mnemonic converter, an LD application program is converted to a program that consists of LD mnemonics which are not described by Kim. Then, the macro compiler translates each mnemonic into an assembly code block specific to the main processor, equivalent to the processor 101 in Figure 11 of the present patent application. Finally, the assembler generates an executable binary code, like the C-language compiler 102 in Figure 11 of the present patent application. The assembler reduces both the size of the memory required and the translation time needed, according to Kim. Thus, in Kim the execution code is optimized *when the programming language is converted into execution code*, not before the control program is compiled by the compiler.

In the control program development supporting apparatus of claim 2, the optimization filtering unit provides an optimization not available through the compiler. The optimization filtering unit converts an original control program into another language, such as C, that increases the effectiveness of the compiler. In other words, the compiler does not compile a C language program that has been converted to a C language directly from the original control program. Instead, the optimization filtering unit intervenes. A conventional compiler compiles the control program in an advanced programming language such as C and performs some optimization by deleting redundant codes and intermediate variables. As part of a basic optimization feature of known

compilers, sequences of instructions are replaced to accelerate execution as in pipeline logic. However, the conventional compiler does not replace sequences of instructions in order to improve a hit ratio in a cache with respect to instructions that are at remote locations with respect to each other in the program.

The optimization filtering unit of the invention replaces sequences of instruction in the program to improve the hit ratio and execution efficiency. By collecting instructions referring to the same input and output devices, the probability that the instruction code which accesses these devices will exist in the cache increases, thereby accelerating processing of the program. In the invention, an editor of the control program, such as an LD, can interpret the control program so that a comprehensive change in the program is possible. Variables that are not cited and redundant codes are excluded in conventional compiler optimization. However, the conventional compiler cannot collect instructions for common input and output devices and place them proximity to each other as in the invention. Even common input devices can be identified by different variable names so that a compiler can only process for character strings and cannot determine whether different variable names concern common input and output devices. In the present invention, the optimization unit edits input and output devices and manages input and output devices with a control program editor. This feature is not found in Kim.

Aho only describes well known compiler optimization techniques, such as redundancy elimination, in Section 9.9 and 10.2. However, even if Aho is employed to modify Kim, the combination does not describe the optimization filtering unit of claim 2 so that *prima facie* obviousness of that claim cannot be established from the proposed combination.

Amended claim 5 describes the control program development supporting apparatus that comprises the control program dividing unit and a compiler. The control program dividing unit divides the control program into blocks with each block including at least one rung of a ladder program. According to the Office Action, this claim is anticipated by Kim.

In citing Kim, the Examiner directed attention to its Figure 4(a), asserting that that figure clearly shows a ladder program part. However, the accompanying comments of

the Office Action do not define what in Kim is the control program nor what are blocks including at least one rung. In the invention, the minimum unit of a block is one rung of a ladder program. A block can also include a plurality of the rungs. The ladder program consists of a combination of input instructions and output instructions. In the invention, by dividing the control program into the blocks, i.e., files, the compiler can compile these blocks in units of blocks.

In Kim, a block refers to a set of instructions to be handled as a unit in stack manipulation during program execution. While it may appear, at first glance, that Kim defines blocks in a way similar to claim 5, and other claims, in fact, a “block” of Kim is a set only of input instructions and does not include any output instructions. Therefore, since there is no identity between the “block” of Kim and the blocks of claim 5, Kim cannot anticipate claim 5.

Furthermore, in the invention, the blocks obtained by dividing the ladder program, when compiled, do not result in pipeline stall because the rungs do not include jump instructions. Accordingly, in the invention, high speed processing is achieved through improved pipeline efficiency. By contrast, in Kim, “blocks” include jump instructions because each “block” of Kim includes only input instructions of the ladder program and thus becomes a sub-routine. Because of the presence of the jump instructions in Kim, only low speed processing, as compared to the invention, can be achieved. Because of these several differences between Kim and the invention as defined by claim 5, Kim cannot anticipate that claim nor the rejected dependent claims 7-9.

Claim 10 is patentable over the asserted combination of Kim and Aho for two different reasons. First, claim 10 depends from claim 5 and the rejection of claim 10 is founded upon the assertion that claim 5 is anticipated by Kim. For the reasons already presented, there is no such anticipation. Second, claim 10 includes the optimization unit also mentioned in claim 2. For the reasons already presented in distinguishing claim 2 from the asserted combination of Kim and Aho, claim 10 is also patentable over that asserted combination.

Claim 11 also depends from claim 5 and is patentable over the asserted combination of Kim and Chester. The rejection is founded upon the assertion that claim 5

is anticipated by Kim, an assertion that cannot be properly maintained. The rejection of claim 11 should be withdrawn.

Claim 12 is an independent claim that includes all of the limitations of claim 5 and, in addition, a control-program converting unit. Claim 12 was rejected as unpatentable over Kim in view of McGrath, with McGrath being cited as meeting the control-program converting unit of claim 12, the part of claim 12 not appearing in claim 5. Kim was relied upon as describing all of the elements of claim 12 that are common to claims 5 and 12. However, for the reasons supplied above, Kim does not anticipate claim 5. Therefore, even if Kim were modified by McGrath and McGrath did supply the control-program converting unit of claim 12, *prima facie* obviousness would not be established because Kim does not supply all the elements of claim 12 that are also present in claim 5. Accordingly, further discussion of the rejection of claim 12, and of its dependent claims 14-16, which were commonly rejected with claim 12, is not necessary.

The limitation of amended claim 14 is identical to the limitation of amended claim 7. Therefore, for the additional reason presented above with regard to the distinction between the limitation of claim 7 and Kim, claim 14 is patentable over the asserted combination of Kim and McGrath.

The limitation of claim 15 is identical to the limitation of claim 8. Therefore, for the additional reason presented above with regard to the distinction between the limitation of claim 8 and Kim, claim 15 is patentable over the asserted combination of Kim and McGrath.

The limitation of claim 16 is identical to the limitation of claim 9. Therefore, for the additional reason presented above with regard to the distinction between the limitation of claim 9 and Kim, claim 16 is patentable over the asserted combination of Kim and McGrath.

The limitation of amended claim 17 is identical to the limitation of amended claim 10. The limitation of each of those claims was asserted to be disclosed by Aho. Even making the assumption that Aho includes such disclosure, claim 17 is patentable because claim 12, from which claim 17 depends, has been demonstrated to be patentable over the asserted combination of Kim and McGrath. Further, the optimization filtering unit of

claims 2, 10, and 17, for the reasons presented with regard to the rejection of claim 2, is not present in Kim. McGrath was not asserted to disclose that optimization filtering unit. For each of these reasons, separately considered, *prima facie* obviousness has not been established with regard to claim 17.

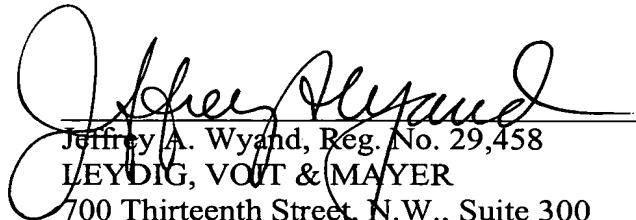
Claim 18, rejected on the same ground as claim 12, from which claim 18 depends, and further in view of Chester, is patentable because *prima facie* obviousness has not been established for independent claim 12. Further, the limitation of claim 18 is identical to the limitation of claim 11. As discussed with regard to claim 11, none of the references cited makes a rough estimate of the processing time for the control-program-developmental supporting apparatus by selecting the sample program that is most similar to the control program and for which processing time is known. Thus, *prima facie* obviousness has not been established on any of these grounds with regard to claim 18.

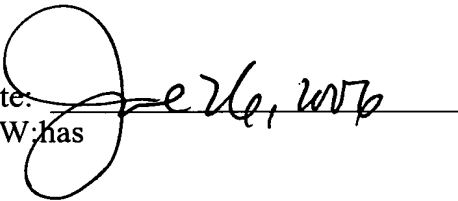
Claim 26, an independent claim, was rejected as anticipated by Kim. Amended claim 26 incorporates all of the limitations of claim amended 5 and includes further limitations. As discussed above, Kim cannot anticipate claim amended 5. For that reason, Kim cannot anticipate claim 26, a still more detailed claim. Applicants incorporate by reference the arguments previously presented against the rejection of claim 5 and make the same arguments with regard to the rejection of claim 26.

Claim 27 includes the limitations of claim 26 and additional limitations. Claim 27 was rejected as obvious over Kim in view of McGrath. Just as Kim cannot anticipate claim 5 or claim 26, for the same reasons Kim cannot anticipate the more limited claim 27. Therefore, it is sufficient in responding to the rejection to again incorporate by reference and assert against the rejections of claim 27 the same arguments presented with regard to the rejection of claim 5.

For the foregoing reasons, all the rejections are respectfully traversed. For the reasons supplied, and in view of the foregoing amendments, upon reconsideration, all rejections should be withdrawn and all of the remaining pending claims should be allowed.

Respectfully submitted,


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